NAC Executive Insights

Safety Insight: Material Degradation

Key Points

- Failures due to material degradation--especially corrosion, fatigue, and reuse without inspection—are often slow-developing but catastrophic when triggered.
- These failures typically involve reused components, marine-exposed materials, or legacy structures with undocumented service histories.
- Visual inspection alone is insufficient; degradation is often internal, progressive, and invisible until failure.
- Governance interventions—such as certified inspection protocols, traceable tagging systems, and reuse bans without engineering approval—are essential.
- This insight outlines the operational signature, governance triggers, and training priorities needed to address this failure mode.

When Aging Materials Become Structural Liabilities

In construction, materials are expected to perform under load, resist environmental exposure, and maintain integrity over time. But when degradation sets in—through corrosion, fatigue, or undocumented reuse—those expectations collapse. Material failure is rarely sudden. It's the result of slow decay, missed inspections, and assumptions that old components are still fit for new use.

These failures are especially common in retrofit projects, marine environments, and temporary structures where reused components are prevalent. Tower sections, suspension cables, scaffold frames, and anchor bolts—all can degrade silently until the moment of failure.

What makes this failure mode systemic is the reliance on visual inspection and undocumented reuse. Crews often assume that if a component "looks fine," it is fine. But corrosion can be internal, fatigue can be cumulative, and prior damage can be hidden beneath paint, rust, or weld overlays.

Representative Case: Tower Section Collapse Due to Reused Components

A broadcast tower collapsed during routine maintenance when a reused diagonal member failed under tension. The component had been salvaged from a previous structure and installed without inspection or certification. The failure initiated a progressive collapse, killing one worker and damaging adjacent infrastructure.

Post-incident analysis revealed internal corrosion and fatigue cracking that had gone undetected. No non-destructive testing (NDT) had been performed. The component had no traceable history, and no tagging system was in place. The collapse was attributed to material degradation—but the root cause was governance absence.

Why This Failure Mode Persists

Material degradation is often invisible until failure. Several systemic factors contribute to its recurrence:

- **Undocumented Reuse:** Components are frequently reused without inspection, certification, or traceability.
- **Visual Inspection Reliance:** Crews rely on surface appearance, missing internal corrosion or fatigue.
- **No Tagging System:** Materials lack traceable identifiers, making it impossible to verify service history.
- **Marine and Environmental Exposure:** Structures exposed to salt, moisture, or temperature cycles degrade faster than assumed.
- **Inspection Gaps:** NDT protocols are rarely enforced, and inspection intervals are often undefined.

These failures are not just technical—they are procedural. They reflect a lack of governance discipline in how materials are tracked, inspected, and approved for use.

Governance Triggers and Operational Controls

To prevent failures due to material degradation, governance must assert control over reuse, inspection, and traceability. Recommended controls include:

- **Certified Inspection Protocols:** All reused or legacy components must undergo certified inspection, including NDT where applicable.
- **Traceable Tagging Systems:** Materials must be tagged with unique identifiers linked to inspection records and service history.
- **Reuse Bans Without Approval:** No component may be reused without engineering approval and documented inspection.
- **Environmental Exposure Audits:** Structures exposed to marine or corrosive environments must be audited for degradation risk.
- **Inspection Interval Enforcement:** Defined inspection schedules must be tied to component type, exposure level, and service duration.

These controls ensure that aging materials are not silently embedded into new structures—and that degradation is caught before it cascades.

Training Priorities and Cultural Shifts

Material governance requires both technical training and cultural reinforcement. Recommended modules include:

- **Corrosion and Fatigue Literacy**: Crews must understand how materials degrade, how to recognize signs, and how to respond.
- **Inspection Protocols**: Training should cover visual inspection limits, NDT techniques, and documentation standards.
- **Tagging and Traceability**: Workers must be trained to use tagging systems, log inspections, and verify component history.
- **Regulatory Compliance**: OSHA, ANSI, and ASME standards for material integrity must be embedded in practice.
- **Case History Briefings**: Real-world failures due to degradation should be studied to reinforce the consequences of reuse without inspection.
- **Safety Culture Activation**: A mature safety culture ensures that reused or legacy components are not just inspected—they are questioned, verified, and tracked through shared accountability. Toolbox talks, Accident Hazard Analyses, and pre-task planning must embed material risk into daily routines, supported by leadership commitment and field-level vigilance.

This training must be paired with a cultural shift: materials are not inert. They age, degrade, and fail—and governance must treat them accordingly, reinforced by a safety culture that prioritizes proactive inspection, traceability, and continuous improvement.

Why This Insight Matters

Material degradation is a slow-moving threat with fast-moving consequences. When reused components fail, it's not just a technical error—it's a governance failure. These incidents are preventable, but only if inspection, traceability, and approval protocols are enforced.

This Executive Insight provides a roadmap for prevention. It shows where reuse must be controlled, where inspection must be rigorous, and where traceability must be non-negotiable. It's a call to treat materials not as commodities, but as structural liabilities—ones that demand governance attention from first use to final retirement.

About the Author

Bob Prieto was elected to the National Academy of Construction in 2011. He is a senior executive who is effective in shaping and executing business strategy and a recognized leader within the infrastructure, engineering, and construction industries. Bob received the 2024 ASCE OPAL Award (Outstanding Projects and Leaders) for his Outstanding Lifetime Achievement in Management.